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ABSTRACT

A study was conducted of the capacity of sixth-grade children to communicate accurately paralinguistic affect. A dependent measure indicating the accuracy of paralinguistic communication of affect was obtained by comparing the level of affect which children intended to encode with ratings of vocal inflections from adult judges. Four independent variables were manipulated: (1) the sex of the child doing the encoding (male/female), (2) the literal content of the child's verbal message (positive/negative), (3) the encoder's intended level of vocal intonation (extremely unfriendly, moderately unfriendly, neutral, moderately friendly, and extremely friendly), and (4) the sex of the adult decoder who provided ratings of vocal affect conveyed (male/female). Four hypotheses were tested. The hypothesis that paralinguistic encoding should be more accurate when literal content and intended affect are consistent, rather than inconsistent, was partially confirmed. The hypothesis that negative paralinguistic inconsistency should be more accurately encoded than positive paralinguistic inconsistency was also partially confirmed. Contrary to prediction, male children were more accurate encoders than female children. Finally, as predicted, adult females were more accurate decoders than adult males. Findings are discussed in light of the role of physiological arousal in affecting motor performance according to learning theory. (Author)

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Technical Report No. 441

THE PARALINGUISTIC ENCODING CAPABILITY OF CHILDREN

by Joseph G. Plazewski
and Vernon L. Allen

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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WISCONSIN RESEARCH AND DEVELOPMENT CENTER FOR COGNITIVE LEARNING

Technical Report No. 441

THE PARALINGUISTIC ENCODING CAPABILITY OF CHILDREN

by

Joseph G. Plazewski and Vernon L. Allen

Report from the Project on
Studies of Instructional Programming
for the Individual Student

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Abstract

A study in the capacity of sixth-grade children accurately to communicate paralinguistic affect was conducted. A dependent measure indicating the accuracy of paralinguistic communication of affect was obtained by comparing the level of affect which children intended to encode with ratings of vocal inflections from adult judges. Four independent variables were manipulated: (1) the sex of the child doing the encoding (male/female), (2) the literal content of the child's verbal message (positive/negative), (3) the encoder's intended level of vocal intonation (extremely unfriendly, moderately unfriendly, neutral, moderately friendly, and extremely friendly), and (4) the sex of the adult decoder who provided ratings of vocal affect conveyed (male/female). Four hypotheses were tested. The hypothesis that paralinguistic encoding should be more accurate when literal content and intended affect are consistent, rather than inconsistent, was partially confirmed. The hypothesis that negative paralinguistic inconsistency should be more accurately encoded than positive paralinguistic inconsistency was also partially confirmed. Contrary to prediction, male children were more accurate encoders than female children. Finally, as predicted, adult females were more accurate decoders than adult males. Findings are discussed in light of the role of physiological arousal in affecting motor performance according to learning theory.

Review of the Literature

on

PARALANGUAGE IN EMOTIONAL COMMUNICATION AND SOCIAL INFLUENCE

Loafe with me on the grass....loose the stop from your throat,
Not words, not music nor rhyme I want....not custom or lecture,
not even the best,
Only the lull I like, the hum of your valved voice.

(From Walt Whitman's "Song of Myself" in the 1855 edition of Leaves of Grass)

Major poets throughout history have understood and used the musicality of diction (sometimes regardless of literal content) to convey emotional meaning; occasionally, the noncontent aspects of ordinary language have been celebrated as in the passage by Walt Whitman. In recent times, social psychologists and linguists have employed laboratory techniques to investigate the capacity of human beings to encode and decode paralinguistic messages. Studies in paralinguistics will be reviewed as they pertain to two general themes: The first section will examine the paralinguistic aspects of encoding and decoding emotional meaning, and the second section will discuss paralinguistic components of speech as a means of social influence.

Before examining particular studies, a word is in order about what is meant by "paralanguage." In a broad sense, paralinguistic aspects of speech include all audible vocal characteristics that co-exist with verbal utterances but are not the content of the utterances. They are more the "how" of things that are said than the "what." Professional linguists have developed more complex analytic classifications of components of speech, of course. The scheme most frequently employed by American writers is based on the system presented in 1958 by George

Trager, a linguist. In Trager's system, paralanguage has two subsets: vocalizations and voice qualities. Vocalizations are "variegated... noises not having the structure of language." Vocalizations would include: (a) vocal characterizers such as laughing, crying, and belching, (b) vocal qualifiers such as intensity, and pitch, and (c) vocal segregates such as "uh-uh" for negation, and "uh-huh" for affirmation. Voice qualities are "modifications of all the language and other noises." Voice qualities include pitch range, resonance, articulation control, vocal lip control, and tempo of speech. Overall, however, the bulk of social psychological research here reviewed is less analytic, focusing instead on differences in meaning conveyed by the hum of one's valved voice.

Paralinguistic aspects of the communication of emotional states

One major thread of research in social psychology has investigated the contribution of noncontent aspects of language to the effective communication of emotional states. The present section reviews findings that pertain to this broad topic. The bulk of empirical research in this area has been conducted by Joel Davitz and his associates, and is reported in a book entitled The Communication of Emotional Meaning (Davitz, 1964). Davitz' exploration of paralinguistics originated from his concern as a clinical psychologist with the practical problem of training his graduate students to "listen with the third ear" to the verbal statements of clients. This concern with applied psychology generated the series of basic scientific research reviewed here.

The first study by Davitz and Davitz (1959a) asked the fundamental question of whether role-played emotional states could be reliably

communicated by paralinguistic qualities of speech. In the first phase of the experiment, stimulus materials were prepared by having four males and four females (of college age) recite the alphabet 11 times. They encoded the alphabet once in "normal" conversational tones, and then produced vocal intonations for ten different emotional states.
In the next phase of the experiment 30 college-age judges listened to tape recordings of each stimulus person's recitals of the alphabet. After each recital the judges attempted to identify the feeling expressed by selecting one emotional state from a checklist containing the 11 possible emotions. Judges were told that each speaker might express each feeling any number of times, and that the feelings were presented in random order. The judges made a total of 240 judgments in all. By chance alone, each emotion could be expected to be identified correctly 24 times. It was found that each of the 10 emotions (anger, fear, happiness, jealousy, love, nervousness, pride, sadness, satisfaction, and sympathy) was correctly identified more often than expected by chance.

In addition, the study reached the following conclusions: (1) speakers varied markedly in their ability to accurately encode emotional states by paralinguistic means; (2) judges likewise varied greatly in the accuracy with which they decoded the emotions from vocal intonations; and (3) the emotions themselves differed in the accuracy with which they were discriminated (for example, anger was communicated accurately more than 63 percent of the time, whereas pride was correctly identified in only 20 percent of the cases).

In a follow-up study related to the latter finding, Davitz and Davitz (1959b) focused on the process of discrimination between non-content vocal expressions of different emotions. The authors hypothesized that <u>similar</u> feelings (such as anger and impatience) would be

less accurately discriminated than would dissimilar feelings (such as anger and sadness). This straightforward negative effect of similarity on discriminability was corraborated by the experimental findings. Unfortunately, however, the manipulated variable (similarity of emotions) accounted for very little of the variance in discrimination, and the study stands as the only existing research on the problem of why various feelings are communicated with differential accuracy. Clearly, this problem constitutes a rich area for future theoretical and empirical exploration.

Another finding in the initial Davitz and Davitz (1959a) study stimulated the research effort of Levy (1964). Phyllis Levy investigated the difference among persons in their ability to encode and decode content-free vocalizations of emotional meaning. Specifically, Levy speculated that a single general ability underlies both the expression of and the perception of emotions. Accordingly, she hypothesized that the following three communication abilities would be positively intercorrelated: (1) the abilitiy to express emotions accurately to others; (2) the ability to accurately identify one's own emotional expressions; and (3) the ability to accurately decode the paralinguistic expressions of emotion by others. Levy also investigated the effect of sex of subject on the three communicative abilities, but proffered no specific hypothesis.

To probe these questions, Levy employed what has since become a somewhat overused means of operationalizing encoding and decoding abilities. Ability to identify vocally expressed feelings of others was measured by utilizing the content standard speech instrument developed by Beldoch (1964). This instrument consists of 37 items

which are tape recorded recitations of content-neutral paragraphs that are intoned with 10 different paralinguistically expressed emotions. The measure is operationally defined as the total number of feelings correctly identified on this instrument. The subject's ability to express feelings vocally to others was measured through a slight variation of this technique. First, tape recordings of subjects' expressions of feelings were obtained by having each subject paralinguistically convey the 10 emotions comprising the Beldoch instrument. Each emotion was recorded twice, resulting in 20 emotional items recorded by each subject. Judges listened to the tape recordings and were asked to identify the emotion being expressed by each item. The number of correct identifications made by judges operationally defined the "ability to express" score for each subject. Finally, the subjects' ability to identify their own paralinguistically expressed feelings was measured two weeks after the initial recordings had been obtained. Each subject listened to her or his own 20-minute tape and attempted to identify the feeling being expressed on each item. The sum of correctly identified items operationally defined the subject's score on self-perception ability.

Levy's results revealed a substantial relationship among the three measures. As hypothesized, the three variables were positively intercorrelated. Moreover, when partial correlation coefficients were computed, the intercorrelations remained statistically significant while controlling both for subject's age and vocabulary ability. Levy also found that verbal intelligence positively correlated with each of the three ability measures. Finally, contrary to naive folklore celebrating the superior intuition of women, Levy found no difference for sex on any

of the three ability measures. Overall, Levy concluded that the data were compatible with the notion that some general factor does underlie the three aspects of emotional sensitivity examined in her study.

Two related studies essentially addressed the question of what this general factor might be. In light of studies by Beldoch (1964) and Davitz (1964), the preponderance of evidence appears to confute the hypothesis that the underlying factor is a personality variable. For example, Beldoch (1964) investigated subjects' sensitivity to emotional expression in three modes of communication: the vocal, the musical, and the graphic. He found sensitivity to music, art, and noncontent vocalizations of emotion to be significantly correlated (positively). However, none of the items on a 300-item adjective checklist reliably covaried with the accuracy of decoding scores in any of the three modes of communication. Only self-reported sensitivity to the emotional expressions of others covaried reliably with scores on the speech and graphic arts instruments. Nevertheless, this variable proved to be statistically independent of scores on Beldoch's musical sensitivity index. Beldoch also found a surprising lack of relationship between both training in art and self-reported interest in art and music on scores of accuracy in all three modes of communication. On the other hand, there was a significant positive correlation between verbal intelligence and scores in all three modes--a finding that is consistent with that of Levy (1964).

But the most cogent data bearing on this issue come from a study by Davitz (1964) which was specifically designed to determine whether personality variables correlate with the ability to identify emotional meanings from paralinguistic cues. In this study, an

atheoretical, shotgun approach was utilized to explore a large number of personality variables. Furthermore, the battery of personality tests was administered twice in a commendable attempt to cross-validate any significant relationships with a second sample of subjects. Included in the battery of personality tests were: (1) the Guilford-Zimmerman Temperament Survey, (2) the Allport-Vernon-Lindzey Study of Values, (3) the Edwards Personal Preference Schedule, and (4) the Psychaesthenia and Hysteria scales of the MMPI. The predicted variable, ability to identify emotional meanings, was measured by responses to the 37-item tape recording developed by Beldoch. Of 33 personality variables, only three correlations attained statistical significance, and these failed to cross-validate in a second sample of subjects.

A second, separate portion of this study by Davitz did find perceptual and cognitive correlates of emotional sensitivity. In this part of the study, four predictor variables were examined, and all four significantly correlated with the predicted variable (accuracy of decoding paralinguistic expressions of emotion). The predictor variables found to have positive correlations were: (1) Auditory Ability--that is, the ability to discriminate sounds in terms of pitch, loudness, time (duration), and timbre; (2) Abstract Symbolic Ability--that is, the ability to deal with abstract symbols as measured by the Progressive Matrices test (Raven, 1947), a test designed to measure Spearman's g factor; (3) Knowledge of Vocal Characteristics--that is, the ability to describe accurately the manner in which different emotions are conveyed by paralinguistic dimensions such as loudness, pitch, timbre, rate, inflection, rhythm, and enunciation; and (4) Verbal Intelligence--

a 40-item vocabulary test developed by Thorndike (1942). The correlation of each predictor variable with emotional sensitivity was, however, somewhat low (taken together, the three variables "explained" only about 40 percent of the variance), and, of course, numerous causal structures can be imputed to the correlations. Nevertheless, the data do suggest that perceptual and cognitive variables rather than personality variables play an important role in emotional sensitivity to paralinguistic cues.

Overall, in light of the morass of nonfindings with respect to personality variables and self-descriptions and because of the frequently replicated finding that verbal intelligence positively correlates with emotional sensitivity, Davitz (1964) was led to conclude that general intelligence (Spearman's g) may itself be the most important factor that underlies an individual's sensitivity to paralinguistic expressions of emotional states.

Before leaving the topic of decoding paralinguistic cues to emotion, several additional findings should be mentioned because they may be regarded as somewhat counter-intuitive. Thus, Blau (1964) scrutinized the time-honored folk belief that blind persons should be better able to decode the emotional intonations of noncontent speech than sighted persons (referred to in folklore as "divine compensation"). Congenitally blind subjects with normal intelligence and no hearing deficiencies were compared to a group of sighted adolescents. Blau found that although blind subjects were better able to identify general sounds from indoor and outdoor activities than were sighted subjects, sighted subjects more accurately identified paralinguistically expressed emotional states than did blind subjects. But this result

obtained only when ability to recognize general sounds was controlled statistically. When ability to recognize sounds was not controlled, sighted and blind subjects did not differ in emotional sensitivity. Blau interprets these results by arguing that everyday sounds are easier to learn than paralinguistic cues to emotion for two reasons. First, he claims they have an obviously more simple structure (i.e., a shattering window is a less subtle sound than the paralinguistic intonation of love). The second reason is that blind persons may have a restricted exposure to emotional expressions and feel social inhibitions about asking for clarification of emotional cues when they do occur. Therefore, blind individuals may simply have less opportunity to learn to discriminate among a diversity of emotionally-loaded, paralinguistic cues than from among emotionally-neutral and simpler general sounds.

Another counter-intuitive finding comes from Hornstein's (1967) study of college freshmen living in a dormitory. Instead of the expected direct positive relation between self-reported compatibility of roommates and their ability to understand each other's paralinguistic expression of feelings, Hornstein found a curvilinear relation between the variables. Roommates with moderate ability to understand one another's noncontent emotional vocalizations were highly compatible, whereas both high- and low-emotionally sensitive pairs were relatively incompatible. The results, however, were correlational.

A related study by Wolf, Gorski, and Peters (1972) investigated the relationship between a dyad's degree of acquaintance and the member's

ability to decode accurately one another's intonations of emotions. These variables were found to be statistically independent. Consistent with previous observations by Davitz, the study did find that both the encoding abilities of speakers and of listeners (on a Beldoch-type instrument) were positively correlated with the accuracy of decoding paralinguistic cues by listeners. Overall, it appears that the paralinguistic role-playing abilities of both encoder and decoder enhance the decoder's ability to understand accurately an encoder's message, but the importance of rapport between communicators is dubious with respect to accuracy of decoding. More controlled experimentation is needed to explore this latter counter-intuitive finding.

One study in which common sense predictions were borne out is found in a study by Dimitrovsky (1964), but unfortunately the design of the research is flawed. Dimitrovsky confirmed the hypothesis that increased age is correlated with increased ability of children to identify correctly the emotional meaning of adult paralinguistic cues. She also found a sex effect on accuracy of decoding--a finding that squarely contrasts with the (better designed) study of adult decoding behavior by Levy (1964) in which no sex effects were observed. Girls were found to be more accurate decoders of emotion than boys at ages 6 through 12, but not at age 5. The proffered interpretation is that role expectations for emotional sensitivity (more salient for girls than for boys) mediate this result.

Unfortunately, Dimitrovsky's interpretation is purely speculative and her study is particularly vulnerable to criticisms of experimenter bias. The subjects identified emotional expressions by pointing

to line drawings that represented different emotions. Given this task, it is very possible that the experimenter who recorded each child's responses in the presence of the child inadvertently biased the results in accord with her own a priori hypothesis. Likewise, it is possible that the experimenter's facial expressions might have inadvertently reflected the emotion being conveyed by stimulus speakers. Children in the study could have simply matched the experimenter's facial expressions to expressions depicted in the line drawing, thereby making the study thoroughly uninterpretable. No precautions are reported by Dimitrovsky which would allay these suspicions. Therefore, the relation between age and paralinguistic sensitivity was not convincingly demonstrated by Dimitrovsky's study.

Before switching the focus of this review to studies pertaining to paralinguistic aspects of social influence (and experimenter bias), I shall make a few critical comments concerning the studies already discussed. Further, I shall make some brief suggestions for future research on paralinguistic encoding and decoding of emotional states.

A somewhat lamentable fixed parameter in all of the studies hitherto discussed is the fact that stimulus materials consisted exclusively of role-played emotional expressions. Clearly, this aspect of the methodology was primarily due to the difficulty of obtaining samples of natural expressions of a wide range of emotions. However, it must be noted that the empirical question remains as to whether findings based on role-played emotions will replicate for naturally-encoded vocal intonations of emotion. Therefore, questions concerning the generalizability and ecological validity of an entire corpus of research are open to future empirical testing.

Furthermore, the studies reviewed have employed an unnecessarily restricted range of laboratory paradigms. In particular, only two techniques have been used to create paralinguistic stimulus materials: stimulus persons either intoned emotions while reciting the alphabet or while reciting a phrase comprised of emotionally neutral words. In fairness to the original research, these techniques may be regarded as innovative and effective ways to eliminate the verbal content of speech, leaving only its paralinguistic features. But by limiting verbal content to a prescripted neutral or nonsense type, researchers might also have unintentionally delimited the nature of encodable paralinguistic cues in unknown ways. It is therefore advisable for future research in this area to utilize a diversity of techniques to generate content-free speech. Several techniques can be noted that are capable of masking the content of unscripted speech: (1) speech can be electronically filtered (although this has the drawback of distorting voice quality by eliminating high frequency sounds); (2) emotional expressions conveyed in foreign languages can be used as stimulus materials; (3) speech can be played backwards; and (4) a recently developed technique called <u>randomized splicing</u> can be employed in which a tape recorded expression is divided into segments of about one-third second duration and then the segments are spliced together in random order (Sherer, 1971). This technique masks both content and sequencing cues while preserving the full voice quality of the speaker.

My final remarks in this section concern interesting topics for future research on paralinguistic emotional messages. Future experimental studies might fruitfully manipulate such parameters as

who encodes emotional messages to whom; that is, the role relation of communicating actors could be studied with respect to accuracy of paralinguistic communication. Thus, a variety of characteristics of the target of emotional messages may determine the manner in which the message is encoded. Likewise, decoding may be contingent on the relation of the decoder to the encoder. To offer one speculation, I would predict that a target of an expression of anger, for instance, would most accurately decode an angry paralinguistic message when he believes that it was encoded by an equal status sender, but would less accurately decode the same message ostensibly from a higher or lower status source. I would make this prediction based on my belief that there are more angry communications exchanged between persons of equal status than between persons of unequal status, and that when angry messages are exchanged between persons of unequal status the norms of encoding may have a special paralinguistic quality (perhaps due to conscious social constraints or to increased physiological arousal). Nevertheless, it would be possible to manipulate experimentally a wide variety of encoder-decoder dyad characteristics along lines such as these, and perhaps find interesting interaction effects with respect to different emotions as a function of the normative distribution of actually occurring expressions in the social structure at large.

Another prime area of research for accuracy studies concerns paralinguistic cues to deceptive messages. Under what conditions and in what manner do noncontent speech characteristics belie the verbal content of dishonest messages? There are two recent experimental studies in paralinguistics that pertain to these questions. In a study

by Basket and Freedle (1974), the duration of a source's hesitation before answering a question was experimentally manipulated. Both extremely short and extremely long hesitations caused target persons to make more attributions of lying than did moderate hesitations.

In a recent study by Scherer, London, and Wolf (1973), an actor was asked to recite a passage in a confident tone of voice and then again in a doubtful tone of voice. A computer-based linguistic analysis showed that confidence by this (single) actor was expressed by increased loudness of voice, a rapid rate of speech, and infrequent short pauses. Furthermore, a group of judges accurately rated the confident voice as more confident than the doubtful voice. Although one must be very cautious in generating questions from only two studies of this nature, it does seem that from the perspective of a person sending a deceptive message, the management of paralinguistic aspects of speech such as hesitations, loudness, rate, etc. becomes problematic in the sense that an appropriate level of confidence in the message must be conveyed (via role playing). The paralinguistic aspects of role-played confidence may differ from those of naturally encoded confidence and be both potentially discoverable by computer analyses and potentially discriminable by judges under some social conditions.

Paralinguistic aspects of social influence

I shall now shift to the task of reviewing some recent literature on the paralinguistic mediation of experimenter bias. Research in this area is of considerable interest for two reasons. First, it is always enlightening to understand the mechanisms of experimenter bias so that design precautions can be taken in experiments in order to

minimize the possibility of artifactual results. But more important for present purposes, some of these findings articulate with broader issues of the relation between paralinguistic aspects of messages and social influence processes.

An early study by Rosenthal and Fode (1963) documented the existence of experimenter expectancy effects. The authors experimentally induced experimenters to hold an hypothesis of either positive or of negative effects with respect to how their subjects would rate the degree of successfulness of people pictured in still photographs. Experimenters were motivated to accomplish their expectations by the promise of extra pay for good data. The results indicated that subjects rated the stimulus photographs as successful when the experimenter expected positive ratings, and as failures when the experimenter held negative expectations.

Recent research indicates that paralinguistic cues constitute one channel by which experimenter bias can be mediated. For example, in a correlational study by Duncan and Rosenthal (1968), motion pictures were made of three male experimenters as they administered an experiment in person perception to ten subjects. The experimenters were chosen on the basis of an earlier study in which each experimenter was known to have obtained data in accord with the bogus hypothesis he had been given. These influential experimenters administered a task (while their voices were being tape recorded) that called for subjects to rate the degree of success or failure of people pictured in still photographs. The tape recordings obtained from each reading of the prescripted instructions were analyzed for several paralinguistic qualities of

vocal expression. It was found that all subjects who heard an experimenter read instructions with a greater vocal emphasis on success subsequently rated the photos as being more successful people than did subjects who heard greater vocal emphasis from an experimenter about failure components in the instructions.

A subsequent study by Scherer, Rosenthal, and Koivmaki (1972) directly manipulated the vocal emphasis of key words in procedural instructions. First, a tape recording was prepared of the standard instructions to the person-perception task (similar to that used in the previous studies). The reading was executed in a neutral way with equal paralinguistic emphasis on both success and failure key words. When the tape was played to subjects, the volume of the key words was experimentally manipulated in the following manner. One group of subjects heard the instructions with the volume of the success words increased, while the volume of the failure words was lowered. Another group of subjects heard the instructions with the volume of success words lowered while the volume of failure words was increased. As predicted, the former group yielded higher success ratings of still photographs than did the latter group, which yielded high failure ratings. Of particular interest for social influence processes generally is that in neither condition did subjects' ratings of suspicion indicate that they were aware of an attempt to influence their ratings.

This result suggests that paralinguistic modulations of the voice may be an important and extremely effective social influence tactic in a wide variety of natural settings, including those conducive to ingratiation. For example, just as Rosenfeld (1966) has found

differential facial and bodily posturing for subjects instructed to seek approval in contrast to subjects instructed to avoid approval of a target person, so might noncontent aspects of speech be activated in the service of ingratiation or approval avoidance. Thus, under conditions of high dependency, the vocal qualities of subjects in a ingratiation paradigm might be more pleasant and likable than would voice qualities of subjects interacting with their targets under low dependency conditions. Furthermore, in face-to-face ingratiation attempts where avoidance of arousing the target's suspicion is a salient concern of the ingratiator, the use of nonverbal gestures and paralinguistic "tactics" may increase while more risky content-based tactics (such as flattery) would decrease. Future research on paralinguistic cues in the service of approval seeking could be very fruitful.

Present Study

Most previous research on paralinguistic communication has focused on the encoding and decoding abilities of adult speakers (Davitz & Davitz, 1959a, 1959b; Levy, 1964). Three experiments have demonstrated the ability of children to decode accurately noncontent aspects of speech produced by adults (Dimitrovsky, 1964; Solomon & Ali, 1972; Solomon & Yeager, 1969). In contrast, the present study extends knowledge of paralinguistic capabilities by exploring for the first time the capacity of children to intentionally encode verbal messages with a variety of vocal intonations. Moreover, the hypotheses tested in the present study, while of basic scientific interest in their own right, bear important practical implications for problems in education.

Inspired by anecdotal accounts and field research demonstrating the educational benefits for tutors and tutees derived from peer tutorial programs (Gartner, Kohler & Riessman, 1971), much recent empirical research has investigated fundamental processes of interpersonal communication that mediate beneficial outcomes when children teach other children (Allen, 1976). Specifically, some recent research has centered on the role of nonverbal behavior in mediating accurate person perception between the tutor and the tutee (Allen & Plazewski, Note 1; Allen & Plazewski, Note 2; Allen & Plazewski, Note 3). It has been argued that the communication of positive interpersonal affect is important to successful tutoring (Allen & Feldman, 1976). And there is recent evidence suggesting that the stylistic aspect of Black English rather than Standard English is preferred for use in a school setting by black children when content is controlled (James, 1976). The stylistic elements leading to this preference were "suprasegmentals or prosodic features of phonology," in other words, vocal intonation. Thus, there is reason to believe that paralinguistic communication is important in maintaining positive affect in teaching situations.

The present study complements and extends the findings of earlier research by focusing on children's ability to communicate interpersonal affect through noncontent aspects of speech. This ability is assessed while the children emit expressions typically used by tutors to provide positive and negative sanctions for the performance of tutees. There are two phases in the present paradigm. First, stimulus children are tape recorded while intentionally modulating several degrees of positive and negative affect in their tone of voice. In a second phase, ratings

are obtained from adult judges who listen to the stimuli. Relating these ratings to the actual level of intonation attempted by the children provides a measure of the accuracy with which the various degrees of role-played interpersonal affect are communicated.

In a broad sense, the study provides data pertinent to the question of whether children have the capacity to intentionally encode different degrees of affect through paralanguage. But beyond such a demonstration, several basic hypotheses are advanced concerning the variables expected to have an impact on the accuracy of paralinguistic communication. Specifically, the effects of the following variables are examined: (1) the sex of the adult listener doing the decoding; (2) the sex of the stimulus child doing the encoding; and most importantly, (3) the relation between the literal content of the teaching expression (positive versus negative sanction) and the five levels of intended, paralinguistic affect (extremely unfriendly voice, moderately unfriendly voice, neutral voice, moderately friendly voice, and extremely friendly voice). In other words, the effect of communicative consistency (i.e., positive content expressed in friendly tones and negative content expressed in unfriendly tones) will be compared with appropriate communicative inconsistency conditions (i.e., positive content expressed in unfriendly tones and negative content expressed in friendly tones).

Hypothesis 1. The first hypothesis predicts that stimulus children will more effectively encode intentional paralinguistic affect under communicative consistency conditions than under communicative inconsistency conditions. That is, accuracy measures from decoders

should show greater accuracy when the affective meaning of the child's intended vocal intonation is consistent with the literal content of the teaching expression than when the vocal intonation is inconsistent with literal content. This result for consistency versus inconsistency is predicted to hold for the appropriate comparisons at both moderate and extreme levels of attempted vocal intonation and for teaching expressions with both positive and negative content. (The neutral intonation level is anomolous for this hypothesis and provides no comparisons germane to the prediction.)

The test of this hypothesis provides an extension of knowledge on communicative properties of paralanguage in two ways. First, earlier studies have failed to address the straightforward question of whether the literal content of an expression delimits the capacity of encoders to communicate affective meaning through vocal intonation. Instead, earlier studies have examined paralinguistic communication of emotion exclusively with phrases whose literal content was affectively neutral or else with utterances that were content-free, such as the alphabet and numerical sequences (Beldoch, 1964; Davitz & Davitz, 1959a; Levy, 1964; Pfaff, 1953). By experimentally varying the degree of positiveness of the literal content of expressions, the present study can reveal the manner in which literal content may delimit the range of affective meaning that can be accurately communicated paralinguistically.

The second reason for testing hypothesis 1 is that, although previous studies have examined the ability of children to decode paralinguistic cues (Dimitrovsky, 1964; Solomon & Ali, 1972), apparently no research has explored the complementary capacity of children to

encode paralinguistic affect. This problem is particularly cogent in the context of research on applied peer tutoring in which the role demands of the tutor frequently require issuing positive and negative reinforcements that may conflict with the tutor's affective responses to personal attributes of the tutee (such as age, race, or sex) as well as reactions to properties of the tutee's performance (such as various patterns of success and failure in learning). By examining the accuracy of paralinguistic encoding in the communication of messages whose literal content and intended vocal affect are experimentally manipulated to be either consistent or inconsistent, the present study paves the way for future research on naturally-occurring paralinguistic betrayal of feelings (or "leakage," to adopt the metaphor of Mehrabian).

Hypothesis 2. Hypothesis 2 predicts a difference when the inconsistency condition for positive literal content is compared with the inconsistency condition for negative literal content. Specifically, greater accuracy in communication is expected for positive content spoken with unfriendly intonations than for negative content spoken with friendly intonations. This hypothesis stems from the speculation that norms of social desirability constrain most of everyday language to be positive in content, leaving negative affect to be conveyed paralinguistically or nonverbally. Consequently, the more common and practiced inconsistency should be positive content with negative paralinguistic leakage. The greater incidence of this form of inconsistency should make it easier to produce effectively at will (possibly because of greater practice or more opportunity for modeling) and

consequently be more accurately judged by decoders than the opposite form of inconsistency.

Hypothesis 3. Hypothesis 3 predicts that female stimulus children will more accurately communicate paralinguistic affect than male stimulus children. This prediction is grounded in previous research from two related areas. First, studies in language development in children have repeatedly demonstrated the greater proficiency of female children with respect to language skills (Maccoby & Jacklin, 1974). To the extent that paralanguage is another manifestation of language development, the predicted sex difference would be expected to hold. Second, research on facial expressions has shown that female children more accurately communicate their reactions to unpleasant stimuli than do male children (Buck, 1975). To the extent that nonverbal behavior and paralanguage are linked, the more nonverbally expressive females should be expected also to encode paralinguistic affect more accurately than males. Overall, either a further dimension of generality or else a newly-found limitation in the expressive skills of female children can be demonstrated by the present study.

Hypothesis 4. The fourth hypothesis predicts that adult female judges will more accurately decode the paralinguistic affect of stimulus children than do adult male judges. Three previous studies support this hypothesis. Dusenberry and Knower (1939) found a trend (which failed to attain statistical significance) for women to be superior to men in judging the vocal intonations from an alphabet recitation task performed by students and instructors in a college speech department. Pfaff (1953) reported a statistically significant

difference (with women showing greater accuracy of decoding than men) on a task where subjects judged the feelings of a male speech instructor reciting numbers. Recent evidence reported by Dimitrovsky (1964) showed that even among children, girls are more accurate decoders of vocal expressions than are boys. However, the findings of Fay and Middleton (1940) showed no reliable difference in sensitivity between men and women, and Levy (1964) obtained no sex differences in the accuracy of adults at decoding vocal inflection from a content-neutral paragraph. Consequently, the question of whether a robust sex difference in paralinguistic decoding ability exists is an open one. Data from the present study bear directly on this question.

It should be pointed out that stimulus children encoded affect paralinguistically on both words and sentences in the present study. Consequently, accuracy of communication can be measured separately on each, providing two classes of dependent measures. If the sex difference favoring the decoding ability of females over males is truly robust, then females should be more accurate in decoding paralanguage from both words and sentences.

Method

Overview

The first phase of the study involved preparation of stimulus materials. Forty children were tape recorded while each of them attempted to encode standard verbal utterances with various vocal intonations according to a prepared litany. In the second phase, 40 adult subjects served as decoders who listened to portions of the stimulus tapes and judged the tones of voice used by each child.

A measure of accuracy of paralinguistic communication was obtained by comparing decoders' judgments with the level of vocal intonation intended by stimulus children. This measure was examined as a function of manipulated variables which included properties of the content of the verbal utterances, the intended level of vocal intonation, the sex of the children doing the encoding, and the sex of the adults doing the decoding.

Encoders

Parental permission was obtained to tape-record the voices of 20 male and 20 female sixth graders who served as stimulus children in this study. The vocal intonations which were encoded by these children comprised the stimulus materials later judged by adult decoders.

Decoders

Decoders were 40 undergraduates (20 males and 20 females) at the University of Wisconsin. Subjects volunteered to participate in a study in education in exchange for a $2.00 payment. Adults rather than children were employed as decoders on the assumption that adult interpreters are the most sensitive available instrument for detecting differences in paralinguistic affect.

Stimulus Materials

Stimulus materials were prepared in a mobile research van parked adjacent to a small-town elementary school. The stimulus children were tape-recorded individually by a male experimenter, who followed a prepared script when guiding the children through each step in the recording session.

The experimenter began each session by explaining that he was interested in the way sixth graders can say particular words (i.e., "right" and "wrong") and particular sentences (i.e., "That was the right answer" and "That was the wrong answer") in different tones of voice. The stimulus child was instructed to "pretend you are teaching another student" while saying each word and each sentence aloud in five different vocal intonations. The child then examined a straight line, 24 cm. in length, which was anchored at the left end with a vertical mark signifying an "extremely unfriendly voice" and at the right end with a mark labeled "extremely friendly voice." The experimenter asked the child to imagine that points along the line corresponded to degrees of friendliness and unfriendliness in vocal intonation. Then the experimenter pointed to appropriate points on the line as illustrations while describing verbally the five levels of vocal intonation the child should try to produce.

The spoken instructions were: "I will ask you to say each word and each sentence once at the left end of the line in an extremely unfriendly voice; once here, in a moderately unfriendly voice; once here in the middle, in a neutral tone of voice; once here in a moderately friendly voice, and once here at the right end of the line in an extremely friendly tone of voice." The experimenter pointed to the appropriate points, equal intervals apart on the line, to correspond with the five parts of this instruction.

The child was then asked to practice saying the word "hello" in the five intonations and to attempt to produce each level of vocal friendliness at the experimenter's request in the manner employed during the actual recording session. Having produced each level of vocal

intonation at least once, the child was permitted to practice freely the stimulus words and sentences for three minutes before the actual tape-recording procedure began.

The tape-recording procedure consisted of the experimenter guiding the stimulus child through a prearranged ordering for the vocal intonations of the words and sentences. The order for the presentation of the words and sentences (i.e., the positive word, the negative word, the positive sentence, and the negative sentence) was determined at random. Each word and each sentence were recited consecutively five times (once for each level of vocal intonation) with the order for the five levels of vocal intonation determined at random. Thus, both the order for presenting the words and sentences (with their positive and negative content) and the order for producing the five levels of vocal intonation for each word and sentence were completely randomized for each child.

In all, 20 vocal presentations were tape-recorded from each child, with the experimenter giving standard verbal descriptions and pointing to the appropriate point on the line when demanding the level of vocal intonation for each recitation. (Appendix I presents the complete text of the experimenter's instructions.) The experimenter recorded five seconds of silence in between each recitation, so the decoders would later use this time to record their judgments on rating scales.

Decoding Procedure

The 40 adult subjects responded in groups of four (two males and two females) in the decoding phase of this study. Each group of decoders listened twice to all of the vocal presentations from four encoders (two males and two females) and judged the vocal intonation

for each recitation after the second listening. This manner of decoding, rather than having a group of decoders listen to all stimulus children, was employed to ensure that fatigue and boredom could not interfere with the decoders' ability to make careful judgments of vocal intonation.

The experimenter told each group of decoders that they would hear sixth graders, in the role of a teacher, attempt to produce different levels of vocal intonation while saying common teaching words and sentences. Decoders were instructed to judge "the degree of friendliness or unfriendliness of just the tone of voice used for each presentation" and to record their judgments by placing a mark at the appropriate place on a line, 24 cm. in length. The line extended from "extremely unfriendly voice" printed at the left end to "extremely friendly voice" printed at the right end, and was identical to the line used by the experimenter in directing stimulus children to encode the various levels of vocal affect. In order to ensure that encoding ability rather than decoding skill was the primary focus of the present study, instructions stressed that judgments should be based on the degree of friendliness of vocal intonation alone, without regard to the literal content of the words and sentences.

When the decoding procedure began, the five recitations for a stimulus child's encoding of a given word or sentence were played once for listening. In this way, decoders were exposed to the range of vocal intonations that the child had produced for that particular word or sentence. Decoders immediately heard the five recitations a second time, and after hearing each recitation they had five seconds of silence during which to judge the vocal intonation used in the foregoing

recitation. Proceeding in this manner, each decoder made a total of 80 judgments (20 for each of four stimulus children).

Independent Variables

Four independent variables were manipulated in the present study: (1) sex of decoder (male/female), (2) sex of encoder (male/female), (3) literal content of the verbal utterance (positive/negative), and (4) the five intended levels of vocal intonation that stimulus children attempted to encode (extremely unfriendly, moderately unfriendly, neutral, moderately friendly, extremely friendly).

The literal content variable was manipulated by making half of the verbal utterances spoken by stimulus children positive in content, and half negative in content. The positive word was "right", meaning correct, and the negative word was "wrong," meaning incorrect. The positive sentence was "That was the right answer," and the negative sentence was "That was the wrong answer."

Five intended levels of vocal intonation were created by asking each stimulus child to encode each word and sentence with the five degrees of vocal affect ranging from extremely unfriendly voice to extremely friendly voice. Before tape-recording each recitation, the experimenter pointed to the appropriate place on a 24 cm. continuum of vocal friendliness while describing the level of vocal affect that the child should attempt to produce. With appropriate substitutions for each of the five levels of friendliness (i.e., extremely unfriendly, moderately unfriendly, neutral, moderately friendly, and extremely friendly), the experimenter's instructions were as follows: "OK, this time I want you to say this in an (extremely unfriendly) tone of voice.

Let your listener know that you are feeling (extremely unfriendly) by using an (extremely unfriendly) tone of voice while you talk; that is, use a tone of voice that would be right here (all the way to the unfriendly end of the line)."

Dependent Variables

Two dependent measures were derived from the judgments of decoders. One measure is the absolute level of paralinguistic affect produced by stimulus children. This variable was operationally defined as the absolute distance, measured to a 10th of a centimeter, of the decoder's judgment (a mark on a line 24 cm. long) from the left end of the line. Responses could range from 0 (indicating "extremely unfriendly voice") to 24 (signifying "extremely friendly voice").

The second, and principal, dependent variable is a measure of the accuracy with which the intended level of paralinguistic affect was communicated. It should be recalled that before stimulus children encoded each level of vocal intonation, the experimenter pointed to one of five points on a line, which corresponded to the degree of friendliness or unfriendliness of the tone of voice the child should attempt to use. The distances from the left end of the line for these intended levels of vocal intonation were: 0 cm. for the extremely unfriendly vocal intonation, 6 cm. for the moderately unfriendly vocal intonation, 12 cm. (the center of the line) for the neutral tone of voice, 18 cm. for the moderately friendly vocal intonation, and 24 cm. for the extremely friendly vocal intonation. The measure for accuracy of paralinguistic communication was operationally defined as the absolute value of the difference between the stimulus child's intended level

of vocal intonation and the decoder's judgment of the level of friendliness communicated by the tone of voice. Scores (absolute differences) on this measure could range from 0 (perfect accuracy of communication) to 24 (least possible accuracy of communication).

Measures for these dependent variables were obtained for both word and sentence data.

Method of Analysis

Data for words and sentences were analyzed separately by analysis of variance. The analysis was performed on data from the adult decoders, who served as subjects. A 2 x 10 x 2 x 2 x 5 mixed design analysis of variance was performed on both absolute judgments of paralinguistic affect and accuracy scores for the communication of paralinguistic affect. The between-subjects factors were: sex of decoder (male/female) and group of decoders (there were ten groups of four decoders). The within-subject factors were: sex of encoder (male/female), literal verbal content (positive/negative), and intended level of vocal intonation (five levels ranging from extremely unfriendly to extremely friendly).

Complete summaries for the analyses of variance conducted on accuracy scores (the principal dependent measure) are presented in Appendices II and III for data from words and sentences.[1] Data reported in the Results section below pertain only to the significant main effects and interactions of the four manipulated variables.

Results

Intentional Modulation of Voice

To determine whether stimulus children had the capacity intentionally to encode the five degrees of vocal intonation required in the present experiment, data from the absolute judgments of vocal

friendliness by decoders were subjected to analysis of variance. Only results for the main effect of level of intonation pertain to the capacity question, and consequently only those results are reported here. Decoders' absolute judgments on word stimuli showed a significant main effect of the level intonation intended by encoders, F (4,80) = 170.21, $p < .001$. Table 1 presents mean friendliness ratings, by condition, for this effect.

Post hoc testing of means revealed that the mean absolute friendliness judgments of 7.61 for extremely unfriendly vocal intonation, 9.66 for moderately unfriendly vocal intonation, 11.80 for neutral tone of voice, 12.77 for moderately friendly vocal intonation, and 15.07 for extremely vocal intonation, were significantly different from one another, $p < .05$, HSD. In other words, children succeeded in intentionally producing degrees of unfriendliness and friendliness in their tone of voice while encoding words.

Similarly, data for absolute judgments of friendliness on sentence stimuli showed a significant main effect of intended level of vocal intonation, F (4,80) = 243.25, $p < .001$. Table 2 presents mean friendliness ratings, by condition, for this effect. Post hoc testing revealed that mean absolute friendliness ratings of 7.56 for extremely unfriendly vocal intonation, 10.63 for moderately unfriendly vocal intonation, 12.29 for neutral tone of voice, 13.61 for moderately friendly vocal intonation, and 15.21 for extremely friendly vocal intonation, were significantly different from one another, $p < .01$, HSD. In other words, children succeeded in intentionally producing degrees of unfriendliness and friendliness in their tone of voice while encoding sentences.

TABLE 1

ABSOLUTE FRIENDLINESS RATINGS BY DECODERS FOR WORD STIMULI AS A FUNCTION OF LEVEL OF VOCAL INTONATION INTENDED BY ENCODERS

INTENDED LEVEL OF VOCAL INTONATION				
Extremely Unfriendly	Moderately Unfriendly	Neutral	Moderately Friendly	Extremely Friendly
7.61_a	9.66_b	11.80_c	12.77_d	15.07_e

Note: Higher means indicate greater friendliness of tone of voice. Means with different subscripts differ at $p < .05$, HSD.

TABLE 2

ABSOLUTE FRIENDLINESS RATINGS BY DECODERS FOR SENTENCE STIMULI AS A FUNCTION OF LEVEL OF VOCAL INTONATION INTENDED BY ENCODERS

INTENDED LEVEL OF VOCAL INTONATION				
Extremely Unfriendly	Moderately Unfriendly	Neutral	Moderately Friendly	Extremely Friendly
7.56_a	10.63_b	12.29_c	13.61_d	15.21_e

Note: Higher means indicate greater friendliness of tone of voice. Means with different subscripts differ at $p < .01$, HSD.

Overall, these results show strongly that stimulus children from the sixth grade had the capacity intentionally to encode different degrees of friendliness through paralinguistic modulation of vocal intonation alone. It is now reasonable to examine data for accuracy scores in order to determine the effect of the independent variables on the children's accuracy of communicating intended levels of affect through paralanguage.

Accuracy Scores for Communication of Words

As previously noted, the summary of the complete mixed design analysis of variance for accuracy scores on word stimuli is presented in Appendix II. Only results for the main effects of the four independent variables and their interactions are described below. It should be noted that for all accuracy scores, smaller means indicate greater accuracy of communication.

Results for accuracy scores on word stimuli showed a significant main effect of sex of decoder, F (1,20) = 10.44, $p < .005$, and a main effect of level of intended vocal intonation, F (4,80) = 119.08, $p < .001$. There was also a significant word content X intended level of intonation interaction effect, F (4,80) = 64.16, $p < .001$. No other main effects or interactions of manipulated variables attained statistical significance on this measure.

As predicted, the main effect of sex of decoder revealed that females were significantly more accurate in decoding tone of voice than males. The mean accuracy of female decoders was 5.38 as compared with a mean of 6.01 for males ($p < .001$).

The main effect of level of intended vocal intonation was not predicted, and probably reflects an unimportant response bias on the part of decoders who tended to provide middling rather than extreme ratings. Mean accuracy scores by condition were: 7.63 for extremely unfriendly intonation, 4.35 for moderately unfriendly intonation, 2.29 for neutral intonation, 5.37 for moderately friendly intonation, and 8.84 for extremely friendly intonation. Thus, accuracy scores were better for neutral and moderate levels of intonation than for the extreme levels of both friendly and unfriendly tones of voice.

Results also showed the predicted interaction effect between word content and level of intonation. Table 3 presents mean accuracy scores by condition for this interaction. Post hoc comparisons of specific means were guided by hypothesis 1. Appropriate comparisons of the accuracy with which affect was communicated by paralanguage for the consistency (i.e., congruent tone and content) and the inconsistency (i.e., incongruent tone and content) conditions yielded the following results.

As predicted, when the positive word was spoken with an extremely friendly tone of voice (consistency), the intended level of paralinguistic affect was communicated significantly more accurately than when the positive word was spoken intentionally in an extremely unfriendly tone of voice (inconsistency); the mean accuracy scores for this comparison were 7.22 and 9.31, respectively, $p < .01$, HSD. Also as predicted, stimulus children more accurately communicated the intended paralinguistic affect when encoding the negative word in an extremely unfriendly tone of voice than when encoding the negative word

TABLE 3

DECODERS' ACCURACY SCORES ON WORD STIMULI
AS A FUNCTION OF WORD CONTENT AND
INTENDED LEVEL OF VOCAL INTONATION

	INTENDED LEVEL OF VOCAL INTONATION				
Word Content	Extremely Unfriendly	Moderately Unfriendly	Neutral	Moderately Friendly	Extremely Friendly
Negative	5.94_a	4.08_b	2.24_c	6.00_a	10.46_d
Positive	9.31_d	4.63_b	2.34_c	4.73_b	7.22_e

Note: Smaller means indicate greater accuracy of communication. Means with different subscripts differ at $p < .01$, HSD. Means that differ by more than .99 differ at $p < .05$, HSD.

in an extremely friendly tone of voice; the mean accuracy scores for this comparison were 5.94 for the consistency condition versus 10.46 for the inconsistency condition, $p < .01$, HSD. According to prediction, there was also significantly greater accuracy for consistency than inconsistency in encoding the negative word at moderate levels of intonation, but this prediction did not hold for the parallel comparison for the positive word. When stimulus children encoded the negative word (consistently) in a moderately unfriendly tone of voice, their intended vocal affect was communicated more accurately ($M = 4.08$) than when encoding the negative word (inconsistently) in a moderately friendly tone of voice ($M = 6.00$), $p < .01$, HSD. The only exception to the predicted difference in accuracy scores between the consistency and inconsistency conditions was observed for the positive word encoded at moderate levels of friendliness and unfriendliness; mean accuracy of decoders' judgments did not differ significantly. Overall, hypothesis 1 received clear support for all appropriate comparisons except the latter.

The other comparisons of interest from Table 3 pertain to predictions from hypothesis 2. As predicted, stimulus children more accurately communicated the intended level of vocal affect when encoding the positive word in an extremely unfriendly tone of voice ($M = 9.31$) than when encoding the negative word in an extremely friendly vocal intonation ($M = 10.46$), $p < .05$, HSD. Similarly, as predicted, stimulus children more accurately conveyed the intended level of vocal affect when encoding the positive word in a moderately unfriendly tone of voice ($M = 4.63$) than when encoding the negative word in a moderately friendly tone of voice ($M = 6.00$), $p < .01$, HSD. Overall, hypothesis 2

was supported by accuracy data from decoders' judgments on word stimuli.

Accuracy Scores for Communication of Sentences

The results of analysis of variance on sentence data are detailed below for the significant main effects and interactions of the four independent variables in the design. A summary of the analysis of variance for the complete design is presented in Appendix III. (It should be remembered that, for all accuracy scores, smaller means indicate greater accuracy of communication.)

Results for accuracy scores on sentence stimuli showed a main effect of sex of decoder, F (1,20) = 6.47, p <.025, a significant main effect of sentence content, F (1,20) = 8.02, p < .025, a significant main effect of sex of encoder, F (1,20) = 5.68, p < .05, and a main effect of intended level of intonation, F (4,80) = 90.61, p < .001. Three interaction effects also attained statistical significance. The interactions were: a sentence content X sex of encoder interaction, F (1,20) = 6.78, p < .025, a sentence content X intended level of intonation interaction, F (1,20) = 6.78, p < .025, and a sex of encoder X sentence content X intended level of intonation interaction, F (4,80) = 3.65, p < .01. No other effects of manipulated variables attained statistical significance on this measure.

As predicted, the main effect of sex of decoder revealed that females were significantly more accurate in decoding paralinguistic affect than males. The mean accuracy score of female decoders (for sentence stimuli) was 5.56 compared with a mean of 5.99 for males (p < .025). Consequently, hypothesis 4 was supported.

There was also an unexpected main effect of sentence content on the accuracy with which paralinguistic affect was communicated. Vocal intonation was more accurately communicated by children on the sentence with positive literal content (M = 5.55) than on the negative sentence (M = 6.01), $p < .025$.

Contrary to prediction, the main effect of sex of encoder showed that male stimulus children more accurately communicated paralinguistic affect than females. The mean accuracy scores for this comparison were 5.59 for males and 5.97 for females, $p < .05$. Thus, hypothesis 3 was not supported.

The unpredicted main effect of intended level of vocal intonation, which was observed on accuracy scores for word stimuli, was also observed on accuracy scores for the sentence stimuli. This probably reflects the identical response bias favoring middling rather than extreme judgments by decoders. Mean accuracy scores by condition were: 7.69 for extremely unfriendly intonation, 5.14 for moderately unfriendly intonation, and 2.54 for neutral tone of voice, 5.07 for moderately friendly intonation, and 8.68 for extremely friendly intonation.

Results also showed an interaction effect between sentence content and sex of encoder. Table 4 presents mean accuracy scores by condition for this interaction. The table shows that when stating the positive sentence, male children encoded paralinguistic affect significantly more accurately than female; the mean accuracy scores for this comparison were 5.24 for males and 5.85 for females, $p < .01$, HSD. However, accuracy scores for male and female encoders did not differ

TABLE 4

DECODERS' ACCURACY SCORES ON SENTENCE STIMULI
AS A FUNCTION OF SEX OF ENCODER AND SENTENCE CONTENT

	SENTENCE CONTENT	
Sex of Encoder	Negative	Positive
Female	6.10_a	5.85_a
Male	5.93_a	5.24_b

Note: Smaller means indicate greater accuracy of communication. Means with different subscripts differ at $p < .01$, HSD.

significantly when the negative sentence was spoken. Overall then, this interaction effect places an important qualification on the main effect of sex of encoder by showing that males are significantly more accurate encoders than females only when encoding the positive sentence (although means for the negative sentences differed in the same direction). This finding highlights the need for the inclusion of verbal content parameters in studies on paralanguage and points to the need for a taxonomy of meaning to assist future theoretical development.

Results showed the predicted interaction effect between sentence content and level of vocal intonation. Table 5 lists mean accuracy scores by condition for this interaction. Post hoc testing of specific means was guided by hypothesis 1. Appropriate comparisons of the accuracy with which affect was communicated by paralanguage for the consistency (i.e., congruent tone and content) versus the inconsistency (i.e., incongruent tone and content) conditions yielded the following results.

As predicted, when the positive sentence was spoken with an extremely friendly tone of voice (consistency), the intended level of paralinguistic affect was communicated more accurately than when the positive sentence was encoded in an extremely unfriendly tone of voice; the mean accuracy scores for this comparison were 6.83 and 8.46, respectively, $p < .01$, HSD. Also as predicted, stimulus children more accurately communicated the intended paralinguistic affect when encoding the negative sentence in an extremely unfriendly tone of voice than when encoding the negative sentence in an extremely friendly tone of voice; the mean accuracy scores for this comparison were 6.48 for the consistency condition and 10.53 for the inconsistency condition, $p < .01$, HSD. However, contrary to prediction, comparisons between

TABLE 5

DECODERS' ACCURACY SCORES ON SENTENCE STIMULI
AS A FUNCTION OF SENTENCE CONTENT AND
INTENDED LEVEL OF VOCAL INTONATION

	INTENDED LEVEL OF VOCAL INTONATION				
Sentence Content	Extremely Unfriendly	Moderately Unfriendly	Neutral	Moderately Friendly	Extremely Friendly
Negative	6.48_{a}	5.09_{b}	2.48_{c}	5.49_{ab}	10.53_{d}
Positive	8.46_{e}	5.19_{b}	2.60_{c}	4.66_{b}	6.83_{a}

Note: Smaller means indicate greater accuracy of communication. Means with different subscripts differ at $p < .01$, HSD.

the consistency and inconsistency conditions for both positive and negative sentences, when they were encoded at moderate levels of intended vocal affect, showed no significant differences.

The other comparisons of interest from Table 5 pertain to hypothesis 2. As predicted, stimulus children more accurately communicated the intended level of paralinguistic affect when the positive sentence was encoded in an extremely unfriendly intonation ($M = 8.46$) than when the negative sentence was encoded in an extremely friendly intonation ($M = 10.53$), $p < .01$, HSD. When the similar inconsistency conditions were compared for the moderate levels of intonation, the difference was in the predicted direction (i.e., $M = 5.19$ for positive sentence/moderately unfriendly voice versus $M = 5.49$ for negative sentence/moderately friendly voice), but statistical significance was not attained.

Finally, Table 6 presents accuracy scores for the sex of encoder X sentence content X level of intonation interaction effect. The comparisons of importance from this table are those guided by hypotheses 1 and 2, except made separately for male and female encoders. Differences between means in Table 6 that exceed 1.51 are significant at $p < .01$, HSD. Inspections of the appropriate comparisons for both male and female encoders reveals results that exactly parallel those just reported for the sentence content X level of intonation interaction effect. In other words, despite the three-way interaction, results for the critical comparisons among consistency and inconsistency conditions are not qualified by the sex of the encoder.

TABLE 6

DECODERS' ACCURACY SCORES ON SENTENCE STIMULI
AS A FUNCTION OF SEX OF ENCODER, SENTENCE CONTENT
AND INTENDED LEVEL OF VOCAL INTONATION

Sex of Encoder	Sentence Content	Extremely Unfriendly	Moderately Unfriendly	Neutral	Moderately Friendly	Extremely Friendly
Female	Negative	7.10	5.20	2.37	5.61	10.21
	Positive	8.95	5.27	2.73	4.74	7.56
Male	Negative	5.86	4.98	2.58	5.37	10.86
	Positive	7.95	5.10	2.46	4.58	6.10

Note: Smaller means indicate greater accuracy of communication. Means that differ by more than 1.51 differ at $p < .01$, HSD.

The only additional finding that warrants attention from Table 6 is that males were significantly more accurate encoders of paralinguistic affect than females only when encoding an extremely friendly intonation for the positive sentence; mean accuracy scores for this comparison were 6.10 for males and 7.56 for females, $p < .01$, HSD. No comparisons between male and female encoders for the positive sentence encoded at any other level of intended vocal intonation attained statisitical significance. This finding further qualifies the finding reported earlier that males are more accurate encoders than females when reciting the positive sentence; that is, although all sex differences for the positive sentence are in the same direction, the difference showing more accurate encoding by males attained significance only at the extremely friendly level of intonation. Thus, the condition which most strongly shows this sex difference has been pinpointed.

Discussion

At the most general level, the present study provides a first demonstration that children of the sixth grade have the capacity to modulate intentionally their vocal intonation of ordinary sanction words and sentences, and effectively communicate different degrees of affect through paralanguage. The data for absolute judgments from decoders, showing the differences intended by encoders among all levels of intonation for both words and sentences, strongly support this conclusion. Consequently, there is ample justification for examining the way the data for accuracy of paralinguistic communication bear on the specific hypotheses of this study.

The first hypothesis predicted more accurate encoding of vocal affect when intonation and literal verbal content are consistent than when they are inconsistent. The hypothesis received partial support in that the effect was observed for the encoding of both words and sentences at the extreme levels of intended paralinguistic affect. Comparisons at the extreme levels of intonation provide the strongest test of hypothesis 1. In conjunction with the reliability of results across words and sentences, the data suggest that the consistency hypothesis warrants strong support at the extreme levels of encoding vocal affect. Literal verbal content (i.e., whether consistent or inconsistent) clearly did delimit the range of vocal affect that both male and female children could encode with high accuracy.

However, this important conclusion holds only for extreme levels of intended vocal intonation. At moderate levels of vocal intonation, consistency versus inconsistency of verbal content did not produce nearly so reliable an effect. At the moderate levels of encoding paralinguistic affect, inconsistency between content and affect resulted in lower accuracy of communication than consistency only for the negative word. The appropriate comparisons for the positive word and the positive and negative sentences did not show significant differences between consistency and inconsistency at the moderate levels of encoding paralinguistic affect.

Why should inconsistency of content lower accuracy of paralinguistic encoding primarily at extreme levels of intonation but not moderate levels of vocal intonation? One possibility could be termed a proprioceptive arousal explanation and is based on the underlying learning theory for social facilitation effects (Zajonc, 1965).

Perhaps the process of intending to produce the extremes of paralinguistic friendliness and unfriendliness involves more self-generated physical arousal than the process of intending moderate levels of vocal affect. If this is true (as the common experience of "trying too hard" might attest), then the learned association of congruency between the content of a verbal message and its paralinguistic usage should be more salient (i.e., have a higher probability of occurrence) at the extreme levels of intentionality. Consequently, this well-learned association would be expected to most powerfully interfere with inconsistent paralinguistic usage (a less well-learned association) under the high arousal of the extreme levels of intentionality, resulting in lowered accuracy of encoding.

In contrast, the moderate levels of intentionality may have involved less self-generated physical arousal. Under this lower arousal, the learned congruency between content and affect would be expected to be less salient and, therefore, less an interference with inconsistent usage. In other words, a self-generated form of social facilitation effect may have accounted for the differential impact of inconsistency under moderate and extreme levels of intended vocal affect.

The single anomalous finding for the negative word (which showed the predicted lowering of accuracy due to incosistency even at the moderate levels of intonation) might be reconciled with this explanation if it could be shown in future research that the learned association between congruent content and usage is exceptionally strong for the word "wrong," or if it could be shown that the inconsistent use of the word "wrong" is for some reason exceptionally arousing even at moderate levels of intonation.

This explanation, if correct, has important implications. It would suggest that due to language learning in socialization, the effectiveness of paralinguistic usage of spoken words may be limited for the speaker by the literal content and tradition of past usage of the utterance, and also by factors that affect the salience in a response hierarchy of the learned association between usage and content through differential arousal. As practical illustrations, the effectiveness of encoding inconsistent content and paralinguistic usage in such behaviors as intentional irony, spoken humor, and lying may be affected by choice of words, practice in the skill of incongruent usage, and situational factors affecting physiological arousal. Theoretical attention should be centered on the interaction of such variables as dimensions of literal meaning, intended usages, and situational factors as they affect accuracy of paralinguistic communication.

The findings also supported the second hypothesis. With respect to both words and sentences, results for the extreme levels of vocal intonation show according to prediction that paralinguistic affect was more accurately communicated when stimulus children encoded positive content in an extremely unfriendly voice (positive content inconsistency) than when negative content was encoded in an extremely friendly tone of voice (negative content inconsistency). At the moderate levels of intonation, the predicted difference between positive and negative content inconsistencies attained statistical significance only for the accuracy data on words, although mean accuracy scores for the comparison of inconsistencies on sentences were in the predicted direction.

It cannot be said with certainty why the predicted difference between positive content inconsistency and negative content inconsistency failed to occur strongly at the moderate levels of intonation for sentences, whereas a strong effect in the predicted direction was observed from the sentence data at the extreme levels of intended vocal intonation. One possible explanation centers on an extension of the reasoning offered for the qualification of the first hypothesis. According to such an explanation, which bears a family resemblance to social facilitation and is in line with the a priori basis for hypothesis 2 concerning differential practice for positive and negative content inconsistencies, the motor performance of speech with positive content and negative affect should be better learned than for negative content with positive paralinguistic affect. Consequently, the greater self-generated physiological arousal involved in encoding extreme levels of vocal intonation should theoretically have created the optimal conditions for observing the predicted difference in accuracy of encoding.

In any event, the bulk of the data supported hypothesis 2. Further research might fruitfully test directly the plausibility of the suggested underlying mechanism for the effect by examining whether positive content inconsistency is the more practiced motor skill and whether intending extreme levels of paralinguistic affect in fact generates greater physiological arousal than encoding moderate levels of affect.

Hypothesis 3, which predicted that female children will have the ability to encode paralinguistic affect more accurately than males,

was not confirmed. Results for the accuracy of communicating sentences showed that males were more accurate encoders than females. However, no difference due to sex of the encoder was found for the ability to accurately encode words. Moreover, with respect to encoding sentences, interaction effects among sex of encoder, literal content, and level of intonation place important restrictions on the generality of this sex difference. In particular, the interaction between sex of encoder and literal content showed that, collapsed across level of intended intonation, males were significantly more accurate encoders of paralinguistic affect than females only for the sentence with positive content and not for the negative sentence. The three-way interaction effect further pinpoints the level of intonation for which this sex difference most strongly holds. Although means for male encoders showed greater accuracy of communication than females at all levels of intonation on the positive sentence, post hoc testing showed that males were significantly more accurate than females only when encoding the extremely unfriendly level of intonation with the positive sentence. This effect is difficult to explain. Perhaps due to differing sex role socialization, males may have had more practice saying positive sentences--particularly positive sentences in extremely friendly tones of voice. Alternatively, the female children, who were in the presence of a male experimenter, may simply have been more reserved in expressing positive statements in varying tones of voice. (But it is difficult to see how such an artifact of the sex of the experimenter could account for the failure to observe a similar effect for encoding the positive word.)

Nevertheless, the importance of these findings concerning hypothesis 3 is manifold. First, by failing to support hypothesis 3, a new limitation to the widely observed superiority of female children in the mastery of verbal skills is now known. Females are not better at paralanguage than male children; in fact, under some conditions, the reverse is true. Second, the importance of including both content and intended usage variables in the study of paralinguistic skills is further highlighted by the finding. Questions of when and how literal verbal content and differential paralinguistic usage may interact in determining accuracy of communication should invite future theoretical and empirical work.

Finally, hypothesis 4 received clearcut support. Adult females were more accurate decoders of paralinguistic affect produced by children than males on both words and sentences. This finding is consistent with the previous work on sex differences in decoding ability (Dimitrovsky, 1964; Dusenberry & Knower, 1939; Pfaff, 1953). Moreover, the present findings show that the effect is truly robust and does not depend upon whether decoders hear words as opposed to sentences, positive as opposed to negative literal verbal content, male or female encoders, or any particular level of intended paralinguistic affect. Such results greatly increase the confidence with which it can be concluded that women are better listeners than men.

Why should such a sex difference be found in decoding? It is possible that there is an innate sex difference among primates which has been selected for in evolution because the female's role in mothering infants may require greater sensitivity to tonal signals of

distress and comfort. Whether this difference is innate or acquired could be determined in nonhuman primates by means of a sensory deprivation experiment where half the male and half the female sample of infant monkeys would be raised without auditory stimulation. Then, after an adjustment period for the monkeys raised in silence, reactions to infant distress and comfort calls could be recorded. If paralinguistic sensitivity of females is learned, the females who were raised without auditory stimulation should show less appropriate mothering responses than females raised with auditory stimulation; if the ability is innate, there should be no differences. Furthermore, if the sex difference is innately determined, female monkeys raised without normal auditory stimulation should show more appropriate responses to infant calls than males raised without auditory stimulation; if the sex difference is learned, there should be no difference between these conditions and the sex difference should emerge only for monkeys raised with normal auditory stimulation. Details for such a design are beyond the scope of this paper. The deprivation study is only suggested to show that the problem of determining whether this sex difference in sensitivity to paralanguage is innate or learned is not, in principle, insuperable--at least with respect to nonhuman primates.

Implications for Future Research

The present study utilized only sixth-grade children as encoders and consequently leaves open the question of whether skill in paralinguistic encoding is positively correlated with age for younger children. (Sixth-graders were the oldest children available from the elementary school which cooperated with the present study, and they were

chosen for encoders because it was anticipated that using older children would maximize the likelihood of providing adequate testing of hypotheses while demonstrating that children of the age commonly used in tutoring programs have the capacity to intentionally modulate their voices.) Since previous research shows that decoding ability increases with age (Dimitrovsky, 1964; Solomon & Ali, 1972) and that encoding and decoding abilities are positively correlated for adult subjects (Levy, 1964), future research might explore the related hypothesis that the ability to accurately encode paralinguistic affect increases with age for children.

In a broader sense, however, the present study bears a relation to previous theory and research on the effects of double-bind messages on listeners' interpretations (i.e., messages conveyed in at least two channels of communication where the meaning conveyed by one channel conflicts with the meaning conveyed by other channels). In particular, it has been hypothesized that consistency between content and noncontent aspects of messages is a desirable quality for parents to achieve when interacting with their children in order not to create psychological disorders (Bateson, Jackson, Haley, & Weakland, 1956). It has been shown that mothers, more often than fathers, produce double-bind situations for their children by using positive facial expressions that conflict with the verbal content of messages (Bugental, Love & Gianetto, 1971). Moreover, research shows that mothers of children with psychological disorders engage in more frequent conflicting messages than mothers of normal children (Bugental, Love, Kaswan & April, 1971).

Although the causal link between double-bind communications and psychopathology has not been firmly established, the theoretical consequences of double-bind situations (for which there is correlational support) are important enough to warrant investigation into the conditions under which conflicting messages do and do not occur. The present study shows that sixth-grade children (an age commonly used in tutoring programs) have the capacity to produce intentionally messages in which paralinguistic affect conflicts with verbal content. On the basis of this result, failure in future research to predict accurately when naturally occurring double-bind communications will be emitted by children cannot be attributed to children's inability to produce inconsistent messages. If it is prudent to avoid double-bind situations, the way is now open to explore the conditions under which conflicting paralinguistic communications are naturally emitted by tutors so that such situations can be prevented.

Future research should examine this basic question: "What properties of the tutee and his performance cause tutors to emit paralinguistic inconsistency with the content of verbal messages?" To answer the question, research might manipulate properties of the tutee and the tutee's performance. For example, the success-failure of the tutee could be varied along with the age of the tutee relative to the tutor (i.e., same age versus younger). Where norms of cross-age condescension exist, one would predict that younger tutees will elicit more pleasant tones of voice than same age tutees. However, an intriguing hypothesis predicts that, under conditions of failure on the part of the tutee, tutors will emit paralanguage that conflicts with verbal

content of their messages more frequently when teaching younger tutees than when teaching same-age tutees. The reason for this prediction is that the effects of failure should elicit negative paralinguistic affect for both ages, but norms of condescension should restrict verbal messages to that which is positive primarily in the cross-age situation. Other factors that might affect paralanguage in natural settings are the sex and race of the tutee and whether the tutee's performance improves, deteriorates, or remains the same over time. While of basic scientific interest in their own right, findings from such research may be of practical value in helping to design optimal tutorial programs.

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Footnote

[1]In the present study, both encoders and decoders were nested within groups. In each of the ten groups (where 4 decoders made judgments of 2 male and 2 female stimulus children), data for the 2 stimulus children of the same sex were averaged for the purpose of simplifying the statistical analyses performed in the study. In other words, all analyses of variance were performed on data that are the average of each decoder's judgments (separately) for the 2 male and for the 2 female stimulus children in each group. This is a conservative procedure yielding fewer degrees of freedom than would a more elaborate analysis utilizing all of the original data points individually. Moreover, a more elaborate design could not have yielded any more information than the present design with respect to main effects and interactions among the four manipulated variables in the study (for which hypotheses are stated).

APPENDIX I

Experimenter's Instructions

Hi. I am interested in the way 6th graders can say words and sentences using different tones of voice. You have probably heard other people say things in a very friendly tone of voice at one time, and in a very unfriendly tone of voice at another time. I want to see if you can do this, too. In particular, I want you to pretend you are teaching another student while you read the words and sentences in front of you. I will ask you to read each word and each sentence out loud five different ways. Each time you say one of them, I want you to use a different tone of voice from the other times. Now read over the words and sentences.

OK, now we will go over what I want you to do in greater detail by asking you to say the word "hello" in five different tones of voice for practice. First, take a look at this line. Try to imagine that your most friendly tone of voice is at this end, and your most unfriendly voice is at this end, and that degrees of friendliness fall in between. I will ask you to say each word and sentence once at the left end of the line in an extremely unfriendly voice; once here in a moderately unfriendly voice; once here in the middle in a neutral tone of voice; once here in a moderately friendly tone of voice; and once here at the right end of the line in an extremely friendly tone of voice. To help you understand, let's practice all five tones of voice with the word "hello".

(five practice trials with "hello")

We will repeat this procedure for each word and for each sentence that you looked at earlier. Do you understand what I will ask you to do?

Before we actually begin to tape-record your voice, I will let you practice the words and sentences on your own for about three minutes. Be sure to say the words in the different tones of voice while you practice.

(three minutes of practice)

OK. Now we'll begin.

Manipulation of Intended Level of Intonation

Extremely Unfriendly Voice

OK, this time I want you to say this in your most unfriendly tone of voice. Let your listener know that you are feeling extremely unfriendly by using your most unfriendly tone of voice while you talk; that is, use a tone of voice the would be right here (point) all the way to the unfriendly end of the line.

Moderately Unfriendly Voice

OK, this time I want you to say this in your moderately unfriendly tone of voice. Let your listener know that you are feeling moderately unfriendly by using a moderately unfriendly tone of voice while you talk; that is, use a tone of voice that would be right here (point) not quite all the way to the unfriendly end of the line.

Neutral Voice

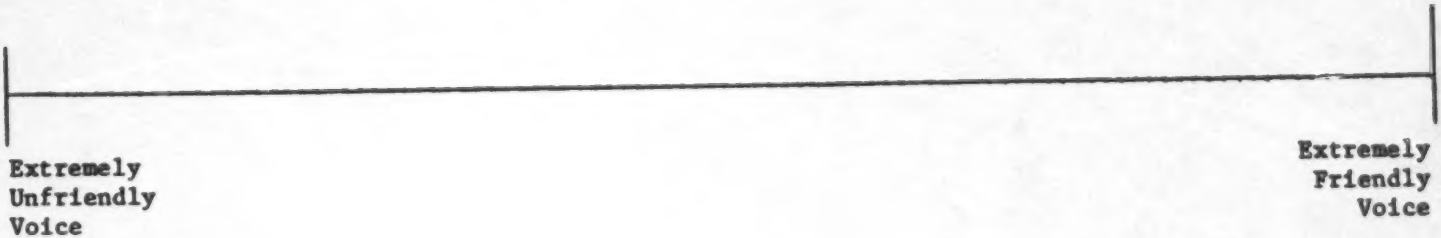
OK, this time I want you to say this in your neutral tone of voice. Let your listener know that you are neither feeling friendly nor unfriendly by using a neutral tone of voice while you talk; that is, use a tone of voice that would be right here (point) at the middle of the line.

Moderately Friendly Voice

OK, this time I want you to say this in your moderately friendly tone of voice. Let your listener know that you are feeling moderately friendly by using a moderately friendly tone of voice while you talk; that is, use a tone of voice that would be right here (point) not quite all the way to the friendly end of the line.

Extremely Friendly Voice

OK, this time I want you to say this in your most friendly tone of voice. Let your listener know that you are feeling extremely friendly by using an extremely friendly tone of voice while you talk; that is, a tone of voice that would be right here (point) all the way to the friendly end of the line.


Extremely
Unfriendly
Voice
Extremely
Friendly
Voice

APPENDIX II

Analysis of Variance on Decoders' Accuracy in Judging the Tone of Voice Used for Word Stimuli

SOURCE	df	MS	F	p
Between Subjects				
Sex of Decoder (A)	1	78.19	10.44	.005
Group (B)	9	40.79	5.45	.001
A X B	9	6.31	.84	n.s.
S/AS (error)	20	8.55	———	———
Within Subjects				
Positive vs. Negative Content (C)	1	1.81	.41	n.s.
A X C	1	.21	.05	n.s.
B X C	9	15.49	3.46	.025
A X B X C	9	3.04	.68	n.s.
SC/AB (error)	20	4.47	———	———
Sex of Speaker (D)	1	11.50	2.68	n.s.
A X D	1	.43	.10	n.s.
B X D	9	33.66	7.84	.001
A X B X D	9	5.92	1.38	n.s.
SD/AB (error)	20	4.30	———	———
C X D	1	1.47	.24	n.s.
A X C X D	1	4.19	.67	n.s.
B X C X D	9	19.20	3.08	.025
A X B X C X D	9	2.42	.39	n.s.
SCD/AS (error)	20	6.24	———	———
Vocal Intonation (E)	4	1086.08	119.08	.001
A X E	4	8.96	.99	n.s.
B X E	36	20.64	2.27	.001
A X B X E	36	7.24	.80	n.s.
SE/AB (error)	80	9.08	———	———
C X E	4	237.19	64.16	.001
A X C X E	4	2.20	.59	n.s.
B X C X E	36	10.27	2.78	.001
A X B X C X E	36	7.41	2.00	.05
SCE/AB (error)	80	3.70	———	———
D X E	4	8.55	1.34	n.s.
A X D X E	4	4.20	.90	n.s.
B X D X E	36	16.63	3.58	.001
A X B X D X E	36	3.74	.81	n.s.
SDE/AB (error)	80	4.64	———	———
C X D X E	4	4.45	1.22	n.s.
A X C X D X E	4	1.99	.54	n.s.
B X C X D X E	36	11.50	3.14	.001
A X B X C X D X E	36	2.99	.82	n.s.
SCDE/AB	80	3.66	———	———

APPENDIX III

Analysis of Variance on Decoders' Accuracy in Judging the Tone of Voice Used for Sentence Stimuli

SOURCE	df	MS	F	p
Between Subjects				
Sex of Decoder (A)	1	38.28	6.47	.025
Group (B)	9	59.70	10.09	.001
A X B	9	7.18	1.21	n.s.
S/AB (error)	20	5.91	———	———
Within Subjects				
Positive vs. Negative Content (C)	1	43.90	8.02	.025
A X C	1	1.50	.27	n.s.
B X C	9	4.05	.74	n.s.
A X B X C	9	4.39	.80	n.s.
SC/AB (error)	20	5.47	———	———
Sex of Speaker (D)	1	30.26	5.68	.05
A X D	1	.50	.09	n.s.
B X D	9	16.34	3.07	.025
A X B X D	9	6.73	1.26	n.s.
SD/AB (error)	20	5.32	———	———
C X D	1	9.86	6.78	.025
A X C X D	1	.29	.20	n.s.
B X C X D	9	4.85	3.34	.025
A X B X C X D	9	2.58	2.24	.10
SCD/AB (error)	20	1.45	———	———
Vocal Intonation	4	907.60	90.61	.001
A X E	4	13.88	1.39	n.s.
B X E	36	22.97	2.29	.005
A X B X E	36	5.96	.59	n.s.
SE/AB (error)	80	10.02	———	———
C X E	4	172.43	48.56	.001
A X C X E	4	5.33	1.50	n.s.
B X C X E	36	10.21	2.86	.001
A X B X C X E	36	4.17	1.17	n.s.
SCE/AB (error)	80	3.56	———	———
D X E	4	7.38	1.97	n.s.
A X D X E	4	5.40	1.44	n.s.
B X D X E	36	10.40	2.78	.001
A X B X D X E	36	4.03	1.08	n.s.
SDE/AB (error)	80	3.74	———	———
C X D X E	4	9.41	3.65	.01
A X C X D X E	4	1.36	.53	n.s.
B X C X D X E	36	7.07	2.74	.001
A X B X C X D X E	36	2.77	1.07	n.s.
SCDE/AB (error)	80	2.58	———	———

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